Functional aspects of head-scratching methods and other preening movements in birds

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FUNCTIONAL ASPECTS OF HEAD-SCRATCHING METHODS AND OTHER PREENING MOVEMENTS IN BIRDS

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1. INTRODUCTION

Most bird species use one of two qualitatively different head-scratching methods. Some species scratch the head by lowering the wing and then bringing up the leg over the shoulder to the head (the overwing or indirect method), other species lift the foot straight up to the head during which the wing position does not change (the underwing or direct method) (*e.g.* Nice & Schantz 1959, Wickler 1961, Simmons 1961, 1964, Sparks 1969, McFarland 1981).

Both types of head-scratching were already described by Heinroth (1917) but their function and evolution still are subject of discussion (*e.g.* Burtt & Hailman 1978). Heinroth (1917, 1938) originally stated that there seemed to be no functional reason for using one method or the other. He suggested that the two methods were useful as taxonomic characters. Wickler (1961) also considered the difference in head-scratching as being of taxonomic significance and although he discussed the question as to which method might be considered to be the evolutionary oldest one, he also did not explicitly relate the difference to a special function. Simmons (1961, 1964) stated that the overwing method is the more advanced one which evolved to counteract differences in balance and in accuracy of scratching. Nevertheless he still considered the head-scratching method as a good auxiliary taxonomic character. This was first doubted by Nice & Schantz (1959) who demonstrated individual and intraspecific variation in head-scratching methods under experimental conditions. Intraspecific variation was also reported by Dunham (1963) and Ficken & Ficken (1968).

In a comparative study of North American wood-warblers (Parulidae), Burtt & Hailman (1978) came to the conclusion that there is virtually no correlation between taxonomy and method of head-scratching. Smith (1975) in a study on the systematics of parrots also concluded that for these species the difference in head-scratching method is "practically valueless for systematic purposes". However, both Burtt & Hailman and Smith found correlates between head-scratching method and other behavioural differences. Among wood-warblers, ground dwelling species tend to scratch the head under the wing and arboreal species over the wing. Burtt & Hailman (1978) ascribed this difference to anatomical changes in species adopted to ground-dwelling. Among parrots, a relation was found between method of feeding and head-scratching method. Prehensile footed parrots mostly scratch under the wing and those species which feed largely from small seeds taken from the ground scratch overwing (Smith 1975).

These latter studies indicate that a more detailed and thorough investigation of head-scratching method in relation to other behaviour may lead to a better understanding of head-scratching methods. However, in the studies presented above the differences in head-scratching method are considered to be a by-product of other functional differences in behaviour or morphology. The reason for the present study was the finding of several differences in preening behaviour between some passerines

and some water birds which suggested a more direct functional explanation for differences in head-scratching and other preening movements.

I shall first present a description of some differences found in preening behaviour and suggest a functional interpretation of these. After this, some experimental evidence supporting this interpretation will be presented. In the discussion attention will be given to the possible evolution of differences in head-scratching methods.

2. MATERIAL AND METHODS

2.1. SPECIES OBSERVED

Most observations were done on passerines, gulls and waders. Occasionally birds of other groups were observed (ducks, fowl, rails, pigeons). The most intensively studied species were: Starling *Sturnus vulgaris*, Carrion Crow *Corvus corone*, Black-headed Gull *Larus ridibundus*, Mallard *Anas platyrhynchos* and Oystercatcher *Haematopus ostralegus*. Starling, Carrion Crow and Oystercatcher were known to use the overwing method, Mallard and Black-headed Gull the underwing method.

2.2. METHOD AND TERMINOLOGY

Preening behaviour following bathing of captive and free living birds was studied. Video recordings were made for detailed analyses of preening movements.

The aim of this study is to examine differences in some body postures during preening and not to give a detailed analysis of preening movements. Therefore only a limited number of behaviour patterns will be dealt with.

Terminology (a detailed description of feather maintenance-behaviour is given by Simmons (1964)):

Wing-beating. A type of drying behaviour consisting of beating both wings through the air while standing (Van Rhijn 1977a, b). This pattern is identical to the wing-flapping mentioned by Simmons (1964).

Stroking. Feathers are taken into the bill which is then moved to the end of these feathers.

Preening. All other movements of the bill with which feathers are manipulated will be indicated as preening.

3. RESULTS

3.1. COMPARISON OF SEVERAL SPECIES

Fig. 1 shows the wing-beating of Mallard, Black-headed Gull and Oystercatcher. As mentioned by Simmons (1964), wing-beating is characteristic for water birds. During wing-beating birds may fly up. Passerines do not show wing-beating, instead the flight from the bathing to the preening site achieves a similar result (Simmons 1964, own obs.). As can be seen in Fig. 1, during beating the wings are moved in such a way that they are not beaten down but forward. During this movement, feathers of the wings are not lowered below the belly. The body is mostly held upright, but the tail remains in a more or less horizontal position.

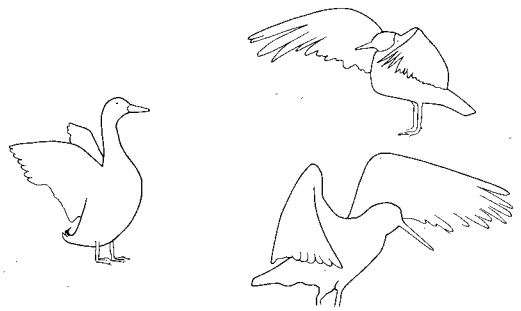

Fig. 1. Wing-beating of Mallard, Black-headed Gull and Oystercatcher.

Fig. 2 shows the stroking of the long tail feathers in Carrion Crow, Black-headed Gull and Oystercatcher. A Crow first lowers the wings, turns the head to the tail while the tail is moved sideward. In the Gull and the Oystercatcher the wings are not lowered and the tail is turned around its axis for more than 45 degrees.

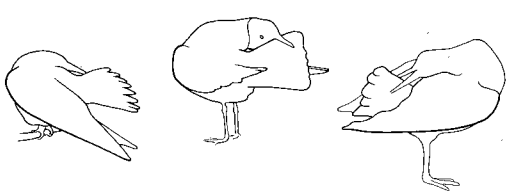

Fig. 2. Stroking of outer tail feathers (right side) in Carrion Crow, Black-headed Gull and Oystercatcher.

In Fig. 3 stroking of the primaries is shown for Starling, Carrion Crow, Black-headed Gull and Oystercatcher. Two different methods are used for this behaviour. The Starling, Crow and most other passerines (*cf.* Simmons 1964, Sparks 1969) use an upright posture with the tail nearly vertically down, then turn their wrists upward and partly spread the primaries. A similar posture is also used for preening the under wing (some other examples are given in Coutlee (1963) and Sparks (1969)). The Gull and the Oystercatcher keep the wings at their sides, turn the head round over the back and, holding the primaries in the bill, move the wingbow forward. The same method was observed in several

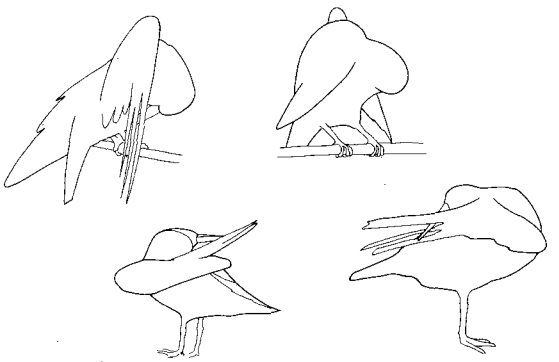

Fig. 3. Stroking of primaries in Carrion Crow, Starling, Black-headed Gull and Oystercatcher.

other species of waders, ducks, geese and rails (Simmons 1964).

Preening of the belly is shown in Fig. 4. Carrion Crow and other passerines lower the wings and keep the tail in a vertical position. Black-headed Gull and Oystercatcher (and several anatidae (McKinney 1965)) maintain a horizontal body posture and only bow the head downward. During preening of breast and flanks too, passerines showed a more uprightposture with the tail pointing down.

What the different postures of Gull, Mallard and Oystercatcher have in common is that during drying and preening movements wings and tail are held in a position preventing any contact with the ground (or, if this behaviour is shown on the water, any lowering beneath the water surface). In contrast, in Crow and Starling wings and tail are lowered, even till below feet level.

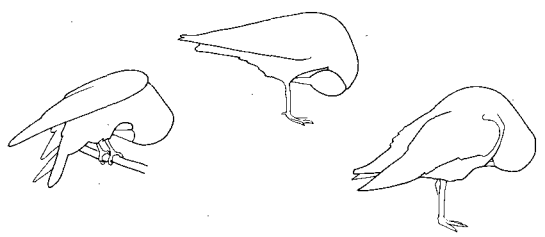

Fig. 4. Preening of belly in Carrion Crow, Black-headed Gull and Oystercatcher.

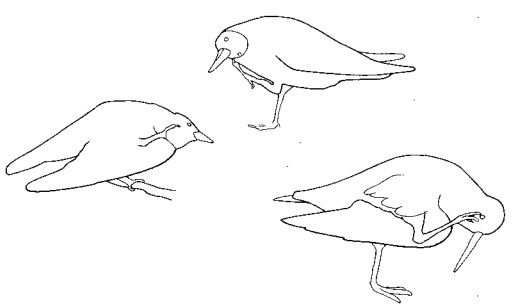

Fig. 5. Head-scratching in Carrion Crow, Black-headed Gull and Oystercatcher.

When we now look at the body postures during head-scratching, the overwing head-scratching of the Carrion Crow and the underwing head-scratching of the Black-headed Gull differ in a similar way as the postures discussed so far (Fig. 5). In the head-scratching of the Crow one wing and the tail are lowered. This is not so in the head-scratching of the Gull. Although the Oystercatcher is showing the same drying and preening behaviour as the Gull (Figs. 1, 2, 3 and 4), it uses the overwing method (Fig. 5).

3.2. EXPERIMENTAL APPROACH OF DIFFERENCES IN HEAD-SCRATCHING AND PREENING

The observations presented above suggest a relation between preening postures, method of head-scratching and the substrate where this behaviour is preferentially shown. Carrion Crow and Starling (and many other passerines) show most preening behaviour and head-scratching when perching; gulls, waders and ducks perform these behaviours on the ground or on water. It seems likely that in the latter species the feather maintenance has become adapted to prevent touching the substrate. Such touching might lead to dirty or wet feathers or, since especially the vulnerable tips of wings and tail are held down, to feather damage. It has for instance been shown (Van Rhijn 1977a) that wet feathers can be bent much further and more permanently than dry ones.

To test whether the head-scratching and preening behaviour of Carrion Crow and Starling when performed on the ground would really result in wing and tail feathers touching the ground, an experiment was carried out in which a group of several captive Starlings and two Crows were kept in cages without perches. In this situation preening behaviour and head-scratching was shown while standing on the ground.

In the Crows it was noticed that wing tips touched the ground during body and wing shak-

ing, stroking of tail feathers and primaries and during head-scratching. The tail touched the ground during body and wing shaking, preening of breast and belly, stroking of primaries, preening of the under parts of the wing and during head-scratching. It was observed that the Crows used a more horizontal body posture during shaking and preening on the ground compared to the postures while perching.

Also the Starlings used a more horizontal posture during shaking and preening. They were able to prevent touching the ground in most behaviour. However, in particular during stroking of the primaries and during head-scratching (Fig. 6), the ground was regularly touched with the wing tips.

From these experiments it can be concluded that: 1) Carrion Crow and Starling do modify their preening behaviour in such a way that, when standing on the ground, touching the ground is prevented as much as possible. 2) head-scratching and primary-stroking are the behaviour patterns in which modification in order to prevent touching the ground seems most difficult.

These conclusions support the idea that feather maintenance behaviour of ground-preening species seems adapted to prevent touching the ground.

4. DISCUSSION

The above findings suggest that differences in preening and in head-scratching methods have a direct functional significance. The difference may be related to the substrate where the behaviour is generally shown.

Ground- and/or water-dwelling species, such as Black-headed Gulls and Mallards, combine preening postures preventing contact with the ground with underwing head-scratching. Observations of birds belonging to other groups, which also preen on the ground or on water (several species of waders, rails and gallinaceous birds) suggest that these species too use preening postures in which lowering of the tail and wings is prevented in combination with underwing head-scratching. As indicated in section 3.2, such postures may be advantageous for several reasons. On the other hand, Carrion Crow and Starling (and many other passerines) mostly preen when perched and use postures in which wings and tail are lowered in combination with overwing head-scratching.

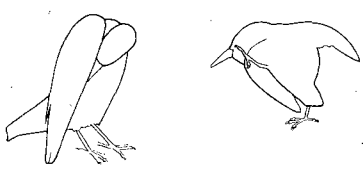

Fig. 6. Primary-stroking and head-scratching in Starling on the ground.

The hypothesis presented here is based on a comparison of birds from very different groups. This raises the question whether differences in head-scratching in much more closely related groups might be explained similarly. An indication for this is found in the study of Burtt & Hailman (1978) on wood-warblers. They found a difference in head-scratching method between ground-dwelling and non-ground-dwelling species. Burtt & Hailman suggested this difference to result from supposed anatomical changes related to ground-dwelling. On the basis of the present findings I suggest that the difference may also be due to a more direct behavioural advantage for ground-dwellers to use the underwing method. This advantage not necessarily has to be related to anatomical changes. However, it will be clear that the relation between substrate and head-scratching method is not an absolute one and should be examined further.

One clear example of a ground-preening bird using the overwing head-scratching method is the Oystercatcher. Many other aspects of the feather maintenance behaviour in this species (see Fig. 1, 2, 3, 4) indicate an adaptation to ground-preening and are similar to those of other waterbirds (own obs.). The contrast between preening and head-scratching postures may be explained in several ways. First, it may be that not only underwinghead-scratching, but also overwing head-scratching is advantageous under certain circumstances. It has been suggested (Ficken & Ficken 1958, Simmons 1961) that in overwing head-scratching the lowered wing may serve to keep a better balance during head-scratching. This can occur either by lowering the centre of gravity; by using the wing to steady the leg during scratching (Simmons 1961), or by placing the wingbow on the perch

as a support for the body (own obs.). Similarly, lowering wings and tail during several other preening movements might also contribute to a better balance. If overwinghead-scratching is advantageous for this or other reasons, it may be that this advantage outweighs the disadvantages of the underwing method.

Another explanation for the presence of overwing head-scratching in the Oystercatcher is that, if at present the overwing method has no special advantage for the birds using it, it may represent an evolutionary old method. This raises the question what can be said about the evolution of head-scratching methods. According to what the assumed advantages or disadvantages of each method were, the answer to this question changed over the years. The oldest view is that the overwing method is the oldest one. Kramer (1930), for instance, argued that the overwing method could be considered to be homologous with the head-scratching method of reptiles and mammals. He also mentioned that the overwing method looked clumsy and therefore supposed it to be an evolutionary old, disadvantageous trait. Wickler (1961) endorsed the arguments of Kramer. However, he also mentioned that young of several species first used the underwing and later the overwing method. This he considered to indicate that the overwing method is the phylogenetically more recent method. He concluded that altogether the arguments did not allow a definite conclusion on what method is the oldest one. Simmons (1961, 1964) and Burtt & Hailman (1979) argued that homologizing of head-scratching patterns between birds and mammals or reptiles is very dubious, given the large morphological differences. They also argued that the underwing method is predominantly used in groups of birds considered to be phylogenetically older ones and the overwing method in more recent groups as the passeres. On basis of these arguments Burtt & Hailman (1979) favour the hypothesis that the overwing method is the most recent one. Simmons (1961, 1964) also favours this idea but mentions as a third possibility that both methods evolved from some intermediate pattern. In my opinion the lack of a correlation between taxonomy and head-scratching method, found by Burtt & Hailman (1979) and Smith (1975), and also the relation between other behavioural traits and head-scratching method found by these authors and in the present article, indicates that differences in head-scratching may be functional for morphological or behavioural reasons. Such correlates may show up in more cases where a more detailed study of the context of head-scratching is made. If several factors were responsible for the advantages and disadvantages of each method, then it may be that both methods have arisen several times in different groups during evolution. In that case, head-scratching cannot be considered to be such a stable and conservative trait as it has been and consequently it should not be excluded that in some groups overwing head-scratching is the evolutionary oldest method, while in other groups it is the most recent one.

Considering the overwing head-scratching in the Oystercatcher, it will be clear that at present no definite conclusion on the function of the use of the overwing method can be drawn. For this, a more detailed comparative study of the preening behaviour of Oystercatcher and other waders, placed against the functional and evolutionary background outlined above, seems necessary.

More study on the ontogeny of head-scratching seems necessary too. The underwing method used by young of several species that show overwing headscratching when adult, is mostly seen as a non-functional evolutionary rudiment. The possibility should be examined that functional reasons are responsible for the use of two methods at different ages. Blase (1960), for instance, argued that the shift from underwing to overwing head-scratching in the Red-backed Shrike *Lanius c. collurio* might be related to differences in balance between young nestlings and older ones.

5. ACKNOWLEDGEMENTS

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6. SUMMARY

This article points to the relation between the use of one

of two distinct head-scratching methods in birds (the overwing or indirect versus the underwing or direct method) and the postures adopted during other preening movements. Black-headed Gull, Mallard and Oystercatcher preen on the ground or on water and adopt postures preventing touching the substrate. Carrion Crow and Starling perch while preening and often keep wings and tail below belly level. The underwing head-scratching method, used by Black-headed Gull and Mallard, also seems best suited to prevent touching the ground, while in the overwing method, used by Carrion Crow, Starling and Oystercatcher, wings and tail are lowered. An experiment in which Carrion Crows and Starlings preened on the ground, showed that the overwing head-scratching and also the stroking of the primaries in these birds (which is different from the primary stroking of the other species) are the postures in which touching the ground can be prevented less. These findings suggest that underwing head-scratching may, in some cases, have evolved to prevent touching the substrate.

The Oystercatcher combines preening postures in which touching the ground is prevented with overwing head-scratching. This exception is discussed, as is the literature on function and evolution of the head-scratching methods.

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8. SAMENVATTING

Vogels krabben hun kop door óf de poot achter de vleugel langs te brengen (de zg. overwing of indirect methode), dan wel door hun poot naar de kop te brengen zonder daarbij de vleugel te betrekken (de zg. underwing of direct methode). In dit artikel wordt aan de hand van waarnemingen aan Kokmeeuw, Wilde Eend, Scholekster, Zwarte Kraai en Spreeuw gewezen op het verband tussen de gebruikte kopkrab-methode en andere poetshandelingen. Kokmeeuwen, eenden en Scholeksters poetsen op de grond of op het water en gebruiken hierbij handelingen waarbij de vleugels en staart niet onder het lichaam naar beneden steken. Deze poetshandelingen gaan bij Kokmeeuw en Wilde Eend samen met underwing kopkrabben. Kraaien en Spreeuwen, die meestal na het baden op een tak zitten tijdens het poetsen, laten vleugels en staart bij diverse poetshandelingen tot onder die tak zakken, zoals dat ook gebeurt bij de door hen gebruikte overwing kopkrab-methode. Kraaien en Spreeuwen die in een experiment op de grond moesten poetsen, vermeden het aanraken van de grond maar dit lukte, vooral met het kopkrabben en het poetsen van de slagpennen, moeilijk. Het underwing kopkrabben is mogelijk ontstaan om te voorkomen dat vleugels en staart de grond raken tijdens het krabben.

In de discussie wordt ingegaan op de Scholekster, die in poetsgedrag overeenkomt met Kokmeeuw en Wilde Eend, maar ook van de overwing krabmethode gebruik maakt. De ideeën die in de literatuur over de functie en evolutie van het kopkrabben naar voren zijn gebracht worden besproken.